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Case review

Additional risk factors for lethal hypothermia

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ABSTRACT

An 86-year-old woman was found dead lying on her back on the floor of an unkempt kitchen. She had last been seen four days before. Her dress was pulled up and she was not wearing underpants. The house was noted to be in "disarray" with papers covering most surfaces and the floor. Rubbish was piled up against one of the doors. At autopsy the major findings were of a fractured left neck of femur, fresh pressure areas over her right buttock, Wischnewski spots of the stomach and foci of pancreatic necrosis, in keeping with hypothermia. No significant underlying organic diseases were identified and there was no other evidence of trauma. Death was due to hypothermia complicating immobility from a fractured neck of femur. This case confirms the vulnerability of frail, elderly and socially-isolated individuals to death from hypothermia if a significant illness or injury occurs. Additional risk factors for hypothermia are also illustrated in this case that involve inadequate housing construction with absent insulation and window double glazing. The approach to hypothermic deaths should, therefore, include checking for these features as well as measuring room and environmental temperatures, evaluating the type and quality of heating and the nature of the floor and its coverings, Given the ageing population in many Western countries, increasing social isolation of the elderly, cost of fuel and electricity, and lack of energy efficient housing, this type of death may become an increasingly witnessed occurrence during the colder months of the year.

1. Introduction

Diogenes syndrome is a complex disorder most often affecting elderly socially-isolated individuals who show variable degrees of self neglect, hoarding and domestic squalor. It has also been termed senile squalor syndrome.[1] Although initially it was noted that many of these individuals were mentally normal with good education and higher socioeconomic backgrounds[2] the syndrome also encompasses cases where there are significant psychiatric illnesses, including schizophrenia, dementia and alcoholism.[1] Particular problems that arise with the forensic assessment of these cases involve putrefaction and animal damage from prolonged post-mortem intervals. Deaths often arise from treatable medical conditions.[3] A death due to hypothermia following a fall with hip fracture is reported in a case of Diogenes syndrome to focus on additional environmental factors that may contribute to such lethal outcomes that may not be considered significant at the time of the initial scene examination.

2. Case report

An 86-year-old woman was found dead at her home address lying on her back on the kitchen floor next to a torn bag of wheat germ. She had last been seen four days before. Her dress was pulled up and she was not wearing underpants. The garden was noted to be very overgrown and the house was in a state of disrepair. There was no sign of forced entry. Inside there was a strong smell of urine and the place was noted to be in "disarray" with papers covering most surfaces and the floor. The kitchen was described as "filthy and unkempt" with piles of dirty dishes. A heavy layer of cobwebs covered some of the doorways. Rubbish was piled up against one of the doors to the outside. Further investigations by police revealed that the decedent lived on her own and had only one living relative. She had been in the habit of ordering large bags of wheat germ (weight = 10 kg) which were delivered to her front door. She would not allow the delivery driver to enter the house but would drag the bag to the kitchen herself and then use a step-stool to place it on a shelf. She was known to be very frail. It appeared that she had

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fallen from the ladder with one of the bags. Minimum overnight temperatures around the time of death ranged from 8.0 to 14.6 °C.

At autopsy the body was covered with wheat germ. The major findings were of a fractured left neck of femur and fresh pressure areas over her right buttock. Wischnewski spots of the stomach and foci of pancreatic necrosis were in keeping with hypothermia. No significant underlying organic diseases were identified and there was no evidence of other injuries. Death was, therefore, due to hypothermia complicating immobility from a fractured neck of femur. A subsequent scene investigation was undertaken to specifically assess the nature of house which was a pre-World War II brick bungalow which lacked double glazed windows, with no wall or floor insulation. There was no underfloor heating. The presence or absence of ceiling insulation could not be assessed. The external doors were noted to have gaps that would have been associated with significant air leakage.

3. Discussion

Hypothermia occurs when the body core temperature falls below 35 °C. It has been associated with greater than 70% mortality when the core temperature drops to 30 °C, and 90% at 26 °C.[4] Unfortunately the pathological findings at autopsy may be quite variable and nonspecific and so careful integration of the scene and autopsy findings with the clinical history is required. The finding of Wischnewski spots within the stomach with low documented environmental temperatures in the reported case was supportive of significant hypothermia.[5] In addition, the fractured neck of femur would have prevented movement, with early pressure ulcers indicating prolonged immobility. The documented social isolation and general untidiness with hoarding were in keeping with Diogenes syndrome.

The colder months of the year are known to be associated with an increase in death rates which has been termed excess winter mortality (EWM). This increase has ranged from 5 to 30%[6] and has been attributed to higher levels of cardiovascular and respiratory illnesses, particularly in the elderly.[7,8] Animal studies have also shown that older rats are less able to tolerate cold than younger rodents.[9] Factors which have been associated with higher levels of EWM include lower expenditure on health, lower incomes and lower expenditure on fuel (so-called "fuel poverty"). Another factor which renders the elderly vulnerable to the effects of cold involves deterioration in physiological and behavioural thermoregulation. Older individuals are less able to discern cold temperatures and do not therefore take steps to dress appropriately, thus increasing body heat loss.[10,11] This is a different phenomenon to paradoxical undressing that may occur in an individual with a significantly lowered core temperature.[12,13] Elderly recluses often do not use heating in an attempt to be 'thrifty', particularly in the face of rising electricity and oil prices,[14] thus compounding the effects of their home's poor energy efficiency.

Of interest, standards of thermal efficiency in homes have also been associated with EMW. Scandinavian countries which have high domestic energy efficiency standards have a much lower increase in winter deaths compared to countries such as Ireland and Portugal. For example Finland which has one of the lowest seasonal variations in mortality has 100% double glazing, with floor, roof and wall cavity insulation in all homes.[6] Adequate heating is also a related problem and it has been shown that the EWM in New Zealand occurs against a background of inadequate domestic heating, with mean domestic temperatures close to or below 16 °C.[15]

The role of the thermal efficiency of domestic premises is not, generally appreciated in the forensic assessment of hypothermic deaths. Hypothermic deaths in temperate climates have been noted in Australia[16] but analyses of Australian homes demonstrates a continued lack of energy efficiency compared to other countries. For example, double glazed windows were present in only 2.6% of Australian homes in 2008,[17] compared to 100% in Finland and Sweden, 98% in Norway, 91% in Denmark, 88% in Germany and 78% in the Netherlands,[6] with 35% of all Australian households having no type of window treatment to reduce heat loss or gain.[17] Heat loss in houses in temperate climates occurs through the ceiling (25–35%), the walls (10–20%), the windows (11–20%), the floor (10–20%) and via air leakage from improperly sealed windows and doors (15–25%).[18]

Significant extra heat requirements (and expense) exist in homes that are not properly insulated, with between 120 and 340% more energy required to maintain comfort.[19] Domestic dwellings without insulation in the ceiling require 100–300% more energy, and those with suspended floors, an extra 20–100%. Houses with air leakage use 24–90% more energy and those with high underfloor ventilation need up to 40% more energy. Removing carpets from wooden floors has the same effect as taking out insulation.[19] Thus non-insulated pre-World War II houses with polished wooden floors and no double glazing of windows (such as the one reported), may be a significant risk factor for lethal hypothermia in winter for elderly reclusive individuals, that is in no way related to poverty.

The lack of socioeconomic gradient in one English study of winter deaths[7] is supportive of the hypothesis that an important factor in hypothermic deaths is inadequate home construction rather than the actual cost of the house *per se*; i.e. failure to adequately insulate and heat any home may transcend socioeconomic factors. In fact it has been suggested that social housing for lower income families may be more energy efficient than other types of dwellings.[20] Certainly this appeared to be the situation in the current case. Although no formal energy assessment was undertaken of the house, it was a well-constructed building in an economically above average suburb built in an era when energy efficiency was not a prime consideration.

The approach to possible hypothermic deaths, therefore, requires careful evaluation of more than just the type and quality of heating. The premises where death occurred should be carefully examined with documentation of the room and environmental temperatures, the nature of the floor and its coverings, the presence or absence of ceiling and floor insulation, the presence or absence of double glazing, and the presence of air leaks around doors and windows. The absence of floor heating may be another factor predisposing to lethal hypothermia in the elderly and infirm.

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Conflict of interest

None.

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